

Appendix H: Comparing ASHRAE/IESNA 90.1-1999 and Seattle Energy Code

This document: "LEED ENERGY BASELINE FOR SEATTLE PROJECTS: A Comparison of *ASHRAE/IESNA Standard 90.1-1999* and the *2002 Seattle Energy Code* (Revised version: 13 June 2002)" was prepared by staff at Seattle's Department of Design, Construction and Land Use to assist City Project Managers with LEED Rating System™ energy prerequisites and credits that reference ASHRAE/IESNA 90.1.

The City of Seattle requires that new City facilities over 5,000 square feet achieve a LEED™ Silver rating. For energy:

1. The Energy and Atmosphere section of the LEED™ program, Energy Prerequisite 1 (Minimum Energy Performance) requires that projects comply with *ASHRAE/IESNA Standard 90.1-1999* or the local Energy Code whichever is more stringent. (*Note that Standard 90.1 was updated in 2001, but LEED has not yet adopted it.*)
2. To ensure that projects comply with the *Seattle Energy Code*, the Seattle Supplement to LEED™ requires that projects achieve a minimum of 2 points (a 20% improvement in energy efficiency) in Energy Credit 1, Optimize Energy Performance.

(The net effect of these two requirements is that projects must comply with the mandatory provisions in **both** *ASHRAE/IESNA Standard 90.1-1999* and the *Seattle Energy Code*.)

This document reviews the mandatory provisions and identifies the baseline for trade offs. In a nutshell:

- The **baseline** for the energy analysis is specified in Section 11 of *ASHRAE/IESNA Standard 90.1-1999*.
- **Mandatory** provisions in *ASHRAE/IESNA Standard 90.1-1999* must always be complied with. This includes Sections 5.2, 6.2, 7.2, 8.2, 9.2, and 10.2 (per Section 11.1.2);
- **Mandatory** provisions in the *2002 Seattle Energy Code* (*2001 Washington State Energy Code with the Seattle Supplement*) must always be complied with. This includes Sections 1310-1314, 1410-1416, 1440-1443, 1450-1454, and 1510-1513 (per Section 2.1 of RS-29);
- **Prescriptive** provisions in *ASHRAE/IESNA Standard 90.1-1999* are allowed to be traded off PROVIDED that those variations are completely and accurately modeled.
- **Prescriptive** provisions in the *2002 Seattle Energy Code* (*2001 Washington State Energy Code with the Seattle Supplement*) are allowed to be traded off PROVIDED that those variations are completely and accurately modeled.
- Notwithstanding the previous item, it is recommended that projects comply with the prescriptive requirements in the *2002 Seattle Energy Code*. Otherwise, the plan review for issuance of building permit gets more complicated. (*Requirements in the Seattle Energy Code can not be traded off unless Energy Code compliance is shown using the annual energy analysis procedure in Reference Standard (RS) 29. Note that Section 1.1 of RS-29 requires that "the building permit application for projects utilizing this Standard shall include in one submittal all building and mechanical drawings and all information necessary to verify that the design for the project corresponds with the annual energy analysis. If credit is proposed to be taken for lighting energy savings, then electrical drawings shall also be included with the building permit application."*)
- Energy analysis shall be done in accordance with Seattle DCLU Director's Rule 14-2001: *Standard Design for Energy Code Analysis for Nonresidential Buildings*.
- Documentation shall be in accordance with Seattle DCLU Director's Rule 14-2001: *Standard Design for Energy Code Analysis for Nonresidential Buildings*.

Reference materials:

- Seattle Supplements to LEED (<http://www.cityofseattle.net/sustainablebuilding/Leeds/default.htm>)
- Seattle DCLU Director's Rule 14-2001: *Standard Design for Energy Code Analysis for Nonresidential Buildings* (http://www2.ci.seattle.wa.us/dclu/codes/dr/dr_index.asp)

NOTE: The 2001 Washington State Energy Code (WSEC) was approved by the Washington State Building Code Council in November 2001 and will take effect statewide on 1 July 2002. The City of Seattle has adopted a 2002 Seattle Energy Code (the 2001 WSEC plus Seattle amendments to the nonresidential portions) that takes effect in a similar timeframe. For information on the Seattle Energy Code, see the Seattle Energy Code website at <http://www.ci.seattle.wa.us/dclu/energy>.

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| ASHRAE/IESNA Std. 90.1-1999: section no. & title | Status | Key Requirements in Standard 90.1 (with corresponding Seattle Energy Code (SEC) information in italics) |
|---|-----------|--|
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| Section 11 is summarized first as it sets the general requirements for energy analysis. The summaries of Sections 4-10 follow in order after Section 11. | | |
| 11.1 Energy Analysis – General | Mandatory | <p>11.1.2 indicates that the project must:</p> <p>(a) comply with 5.2, 6.2, 7.2, 8.2, 9.2, and 10.2; and (b) have a “design energy cost” that does not exceed the “energy cost budget” <i>(SEC 1141.4 requires the use of Reference Standard (RS) – 29 for annual energy analysis. RS-29, Section 2.1 requires that:</i> <i>(a) the project comply with 1310-1314, 1410-1416, 1440-1443, 1450-1454, and 1510-1513; and (b) the “proposed design” “annual energy consumption” be not greater than that for the “standard design”.)</i></p> <p>11.1.5 lists documentation requirements. <i>(The SEC documentation requirements are contained in Seattle DCLU “Director’s Rule 14-2001: Standard Design for Energy Code Analysis for Nonresidential Buildings”.)</i></p> |
| 11.2 Simulation General Requirements | Mandatory | <p>11.2.1 lists necessary features of the analysis tool <i>(see Section 4 of SEC Reference Standard (RS) – 29 for acceptable programs)</i></p> |
| 11.3 Calculation of the Proposed Design | Mandatory | <p>11.3.2 allows projects to use either the Building Area method (9.3.1.1) or Space-by-Space method (9.3.1.2) for lighting. The Building Area values in Table 9.3.1.1 on page 51 are recommended for simplicity and must be used unless lighting calculations are done for each space in the building. See also 11.3.8.</p> <p>11.3.4 requires all spaces to be simulated as being both heated and cooled.</p> <p>11.3.5 requires the analysis to correctly reflect the proposed HVAC system.</p> <p>11.3.8 requires the use of the Building Area method for lighting if the Proposed lighting system has not been designed.</p> <p>11.3.11 requires schedules to match the proposed building. <i>(See Table 3-2 in RS-29 for default schedules.)</i></p> <p>11.3.12 specifies how to zone the building for modeling purposes.</p> |
| 11.4 Calculation of the Budget Building (Standard Design) | Mandatory | <p>11.4.1 requires that the Budget Building “be developed by modifying the Proposed Design”.</p> <p>11.4.2, building envelope, specifies that areas and orientations are to be identical to the Proposed Design except as indicated in (a), (b), and (c).</p> <p>11.4.2(a), opaque assemblies, specifies same heat capacity as the Proposed Design but minimum U-factors per 5.3 - see 5.3.1 below for details.</p> <p>11.4.2(b), roof surfaces to have a reflectivity of 0.30.</p> <p>11.4.2(c), fenestration, specifies no shading projections; fenestration flush to the exterior wall; fenestration area and orientation to match Proposed Design unless area exceeds 5.3.2.1, i.e. 50% of the gross wall area for vertical glazing or 5% of the gross roof area for skylights, in which case the area is to be reduced proportionately on all exposures; U-factor to be the minimum allowed and SHGC to be the maximum for the</p> |

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| | | <p>corresponding fenestration area - see 5.3.2 below for details.</p> <p>11.4.3 specifies that the HVAC system be developed from Figure 11.4.3 and Table 11.4.3A using rules (a) to (k).</p> <p>11.4.3(a) components not listed to be the same as the Proposed Design.</p> <p>11.4.3(b) equipment efficiency to match 6.2 and 7.2.</p> <p>11.4.3(c) fan energy to be broken out separately from efficiency ratings for modeling purposes.</p> <p>11.4.3(d) minimum ventilation rates to match the Proposed Design, heat recovery to match 6.3.6.1.</p> <p>11.4.3(e) air economizer to be Table 11.4.3A per 6.3.1 and 6.3.1.1 for systems 1-4 and 8-11.</p> <p>11.4.3(f) water economizer to be per 6.3.1 and 6.3.1.2 for systems 5-7.</p> <p>11.4.3(g) preheat coil to be controlled in same manner as the Proposed Design.</p> <p>11.4.3(h) supply air delta T to be 20 F, return and relief fan types to match Proposed Design.</p> <p>11.4.3(i) fan system efficiency in BHP per cfm of supply air including belt losses but excluding motor and motor drive losses to be the same as the Proposed Design up to the limit in 6.3.3.1, or to be proportionately reduced if larger.</p> <p>11.4.3(j) equipment capacities to be sized to same percentage of the load as for the Proposed Design, hours of loads not met to be similar to the Proposed Design</p> <p>11.4.3(k) HVAC system to be mapped using Figure 11.4.3 and Table 11.4.3A</p> <p>11.4.4 specifies that the service water heating system is to be same as the Proposed Design except where 7.3 applies.</p> <p>11.4.5 specifies that the lighting is to be determined using same categories as the Proposed Design with lighting power set equal to the maximum allowed - see 9.3.1 below for details.</p> <p>11.4.6 other systems to be the same as the Proposed Design.</p> |
| 11.5 Exceptional Calculation Methods | Mandatory | “Where <u>no</u> simulation program is available that adequately models a design, material, or device, the authority having jurisdiction <u>may</u> approve an exceptional calculation method”. |
| 5. Building Envelope | | |
| 5.2 Mandatory Provisions | Mandatory | |
| 5.2.1 Insulation Installation | Mandatory | 5.2.1.3 generally prohibits recessing equipment into insulation unless trade off calculations are done. |
| 5.2.2 Fenestration and Doors | Mandatory | U-factors, SHGC, and visible transmittance to be based on NFRC ratings. |

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| 5.2.3 Air Leakage | Mandatory | 5.2.3.2 sets maximum air leakage rate for fenestration; 5.2.3.3 requires loading dock weatherseal; 5.2.3.4 requires vestibules. |
| 5.3 Prescriptive Provisions | Baseline | Table B-14 on page 104 contains the requirements for Seattle. Requirements are subdivided into nonresidential, residential, and semiheated categories as defined in 3.2. "Residential" is defined as spaces for living and sleeping, and includes prisons and fire stations. The component-by-component baseline summary below only addresses the nonresidential category, as that is the most common. For residential and semiheated spaces, as defined in 3.2, refer to the appropriate columns in Table B-14. (Note that the SEC requirements also vary by space heat type.) |
| 5.3.1 Opaque Areas | Baseline | Note that the opaque envelope categories differ between Std 90.1 and SEC. |
| 5.3.1.1 Roofs | Baseline (SEC prescriptive) | For nonresidential spaces: U-0.063 for insulation entirely above deck, U-0.065 for metal buildings, U-0.034 for attic and other. (SEC requirement for electric resistance heat: U-0.031 for attics, U-0.034 for all other roofs; SEC requirements for all other space heat: U-0.036 for attics, U-0.050 for all other roofs.) |
| 5.3.1.2 Above Grade Walls | Baseline (SEC prescriptive) | For nonresidential spaces: U-0.151 for mass, U-0.113 for metal buildings, U-0.124 for steel framed, U-0.089 for wood framed and other. (SEC requirement for electric resistance heat: U-0.062 for all opaque walls; SEC requirements for all other space heat: U-0.084 for metal frame walls, U-0.062 for wood frame and other than metal frame walls.) |
| 5.3.1.3 Below Grade Walls | Baseline (SEC prescriptive) | For nonresidential spaces: C-1.14 for all below grade walls (does not include air films or soil). (SEC requirement same as above grade walls.) |
| 5.3.1.4 Floors | Baseline (SEC prescriptive) | For nonresidential spaces: U-0.107 for mass, U-0.052 for steel joist, U-0.051 for wood framed and other. (SEC requirement for electric resistance heat: U-0.029 for all floors; SEC requirements for all other space heat: U-0.056 for all floors.) |

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| 5.3.1.5 Slab on Grade Floors | Baseline (SEC prescriptive) | For nonresidential spaces: F-0.73 for unheated slabs, F-0.95 for heated slabs. (SEC requirement for electric resistance heat and for all other space heat: F-0.54 for unheated slabs, F-0.55 for heated slabs.) |
| 5.3.1.6 Opaque Doors | Baseline (SEC prescriptive) | For nonresidential spaces: U-0.70 for swinging doors, U-1.45 for non-swinging doors. (SEC requirement for electric resistance heat and for all other space heat: U-0.60 for all opaque doors.) |
| 5.3.2 Fenestration | Baseline | |
| 5.3.2.1 Fenestration Area | Baseline | Vertical fenestration area to be 50% maximum, skylight area to be 5% maximum. (SEC does not separate vertical fenestration and skylights and calculates all fenestration area together.) |
| 5.3.2.2 Fenestration U-Factor | Baseline (SEC prescriptive) | For vertical glazing, U-factor requirements vary by fixed vs. operable windows. For nonresidential spaces: 0-40.0% vertical glazing area, % of wall U _{fixed} -0.57, U _{operable} -0.67, 40.1-50.0% vertical glazing area, % of wall U _{fixed} -0.46, U _{operable} -0.47. For overhead glazing, requirements are subdivided into glass skylights with curbs, plastic skylights with curb, and all skylights without curb. For nonresidential spaces: 0-5.0% glass skylight with curb, % of roof U _{all} -1.17 0-5.0% plastic skylight with curb, % of roof U _{all} -1.30 0-5.0% all skylights without curb, % of roof U _{all} -0.69 (SEC does not separate vertical glazing and skylights and calculates all fenestration area together as a percentage of the wall area. SEC does not distinguish between fixed and operable glazing, or between types of skylights. SEC requirement for electric resistance heat: 0-30% total glazing area, % of wall U _{verticalglazing} -0.40, U _{overheadglazing} -0.48; SEC requirements for all other space heat: 0-30% total glazing area, % of wall U _{verticalglazing} -0.55, U _{overheadglazing} -0.66, >30-45% total glazing area, % of wall U _{verticalglazing} -0.45, U _{overheadglazing} -0.54, >45-50% total glazing area, % of wall U _{verticalglazing} -0.40, U _{overheadglazing} -0.48.) |

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| 6. Heating, Ventilating, and Air Conditioning | | |
| 6.2 Mandatory Provisions | Mandatory | |
| 6.2.1 Mechanical Equipment Efficiency | Mandatory | Tables 6.2.1A through 6.2.1G list minimums. Note: The second tier of equipment efficiencies was effective on 29 October 2001. (SEC 1411.3 lists minimum efficiency requirements for combination space and service water heating systems. <i>SEC 1411.4 requires that packaged electric heating and cooling equipment with a cooling capacity greater than 20,000 Btu/h be a heat pump.)</i> |
| 6.2.2 Load Calculations | Mandatory | <i>(Baseline equipment to be sized per D.R. 18-99.)</i> |
| 6.2.3 Controls | Mandatory | 6.2.3.2 requires automatic shutdown, setback controls, optimum start controls, shutoff damper controls, and zone isolation controls for all units with heating or cooling capacity over 65,000 Btu/h and fan power greater than ¾ hp. (SEC 1412.4 requires automatic controls with a minimum 7-day timeclock with a full-load demand over 6,826 Btu/h.) 6.2.3.5 requires automatic controls for parking garage ventilation systems over 30,000 cfm. |
| 6.2.4 HVAC System Construction and Insulation | Mandatory | 6.2.4.2 <i>(duct insulation to be per SEC 1414.2 and Table 14-5.)</i> 6.2.4.3 specifies duct sealing requirements. 6.2.4.4 requires duct leakage testing for ducts operating in excess of 3 in. w.c. |
| 6.2.5 Completion Requirements | Mandatory | <i>(Use SEC 1416.)</i> |
| 6.3 Prescriptive Path | Baseline | |
| 6.3.1 Economizers | Baseline (<i>SEC prescriptive</i>) | Equipment 65,000 Btu/h and larger to have an air or water economizer. <i>(SEC 1423 requires economizers on units having a cooling capacity greater than 20,000 Btu/h., and limits the total capacity of all units without economizer to 240,000 Btu/h per building.)</i> 6.3.1.1 requires return air and outside air dampers to have a maximum air leakage rate of 20 cfm/ft ² at 4.0 in. w.g. 6.3.1.3 requires both air and water economizers to have integrated control so that they are capable of providing partial cooling in addition to the mechanical cooling. 6.3.1.4 prohibits systems that increase building system energy use. Per the 90.1 Users Manual, the following system types would not comply with this requirement: single-fan dual duct systems and some multizone systems (Figure 6-R, pages 6-53 to 6-54), and some water economizer systems (Figure 6-O, page 6-50, and Example 6-OO, page 6-53). |

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| 6.3.2 Simultaneous Heating and Cooling Limitation | Baseline | 6.3.2.1, exception (a) – the compliance option used by most systems – sets a 10% tolerance for volume controllers and temperature restrictions for supply air temperatures. 6.3.2.2 requires bypass and two-position valve for water source heat pump loops |
| 6.3.3 Air System Design and Control | Baseline (SEC prescriptive) | 6.3.3.1 sets a maximum fan system efficiency in hp/1000 cfm 6.3.3.2 establishes performance requirements for part load fan control for fans 30 hp and larger (SEC 1437 requires electronically commutated motors for series fans < 1 hp, SEC 1438 sets threshold at greater than 10 hp, has a prescriptive option of variable frequency drive, and has a performance option similar to 6.3.2.2.) |
| 6.3.4 Hydronic System Design and Control | Baseline (SEC prescriptive) | 6.3.4.1 establishes performance requirements for part load fan control for pumps exceeding 50 hp (SEC 1438 sets threshold at greater than 10 hp, has a prescriptive option of variable frequency drive, and has a performance option similar to 6.3.4.1.) |
| 6.3.5 Heat Rejection Equipment | Baseline (SEC prescriptive) | 6.3.5.1 establishes performance requirements for part load fan control for fans 7.5 hp or larger (SEC 1438 sets threshold at greater than 10 hp, has a prescriptive option of variable frequency drive, and has a performance option similar to 6.3.4.1.) |
| 6.3.6 Energy Recovery | Baseline | 6.3.6.1 specifies exhaust air heat recovery of 50% for systems with over 5,000 cfm and 70% outside air 6.3.6.2 specifies service water heating heat recovery of 60% for systems with over 6,000,000 Btu/h of heat rejection and load over 1,000,000 Btu/h |
| 6.3.7 Exhaust Hoods | Baseline | 6.3.7.1 requires 50% untreated makeup air for kitchen hood systems with over 5,000 cfm 6.3.7.2 requires VAV or heat recovery for fume hood systems with over 15,000 cfm |
| 6.3.8 Radiant Heating Systems | Baseline | 6.3.8.1 requires radiant heating in unenclosed spaces |
| 6.3.9 Hot Gas Bypass Limitation | Baseline | Prohibits the use of hot gas bypass unless the system has multiple steps of unloading |
| 7. Service Water Heating | | |
| 7.2 Mandatory Provisions | Mandatory | 7.2.3 requires pipe insulation for recirculating systems (SEC 1452 prohibits the use of electric resistance as the primary heating source for pool heating for pools over 2,000 gallons.) |
| 7.3 Prescriptive Path | Baseline (SEC prescriptive) | 7.3.1 and 7.3.2 specify efficiencies for combination space and water heating systems (SEC 1411.3 lists minimum efficiency requirements for combination space and service water heating systems.) |

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| 8. Power | | |
| 8.2 Mandatory Provisions | Mandatory | 8.2.1 specifies maximum voltage drop for feeders and branch circuits 8.2.2 contains completion requirements for drawings and manuals |
| 9. Lighting | | |
| 9.2 Mandatory Provisions | Mandatory | |
| 9.2.1 Lighting Controls | Mandatory | 9.2.1.1 requires interior lighting in all buildings over 5,000 square feet to have automatic shutoff controls 9.2.1.4 hotels and motels to have a master switch at the door <i>(SEC 1513.3 requires automatic daylighting controls for all daylight zones. SEC 1513.6 requires occupancy sensors for offices < 300 sf.)</i> |
| 9.2.2 Tandem Wiring | Mandatory | One- or three-lamp fixtures to have tandem wiring |
| 9.2.3 Exit Signs | Mandatory | Exit signs over 20 W to have minimum efficacy of 35 lumens/W |
| 9.2.4 Installed Interior Lighting Power | Mandatory | Lighting calculations to include all lighting power |
| 9.2.5 Luminaire Wattage | Mandatory | Lighting calculations generally to be based on maximum labeled wattage of the fixture |
| 9.2.6 Exterior Building Grounds Lighting | Mandatory | Exterior luminaires over 100 W to have minimum efficacy of 60 lumens/W |
| 9.3 Prescriptive Path | Baseline | |

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